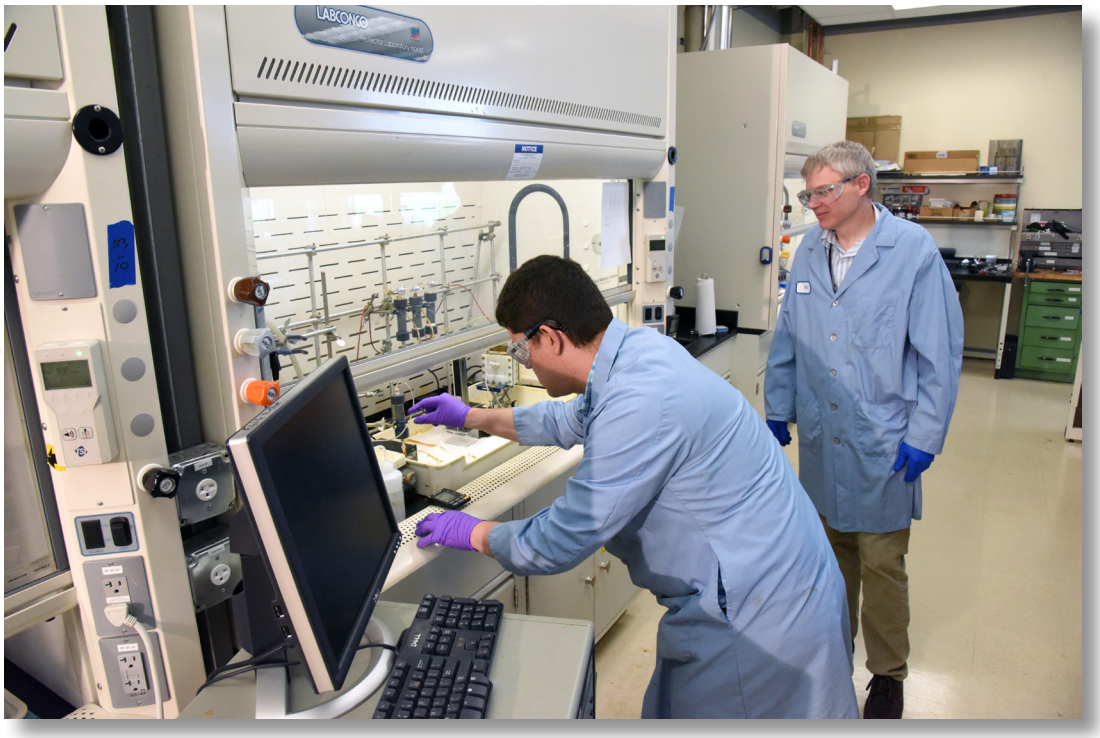

INL Chemical Engineer Luis Diaz and Group Lead Tedd Lister work to develop the electrochemical process for recovery of metals from electronic scrap material.

Electrochemical Recovery

Recycling Rare Earth and High-Value Materials from Discarded Electronics

Idaho National Laboratory has developed a technology to reclaim valuable metals from waste electronic equipment. The Electrochemically Recycling Electronic Constituents of Value (E-RECOV) method uses an electrochemical cell to efficiently recover the bulk of metals from discarded electronics, leading to more complete recycling of materials while significantly minimizing chemical use and waste generation. The process is capable of dissolving the major metals found in electronics and can be used on materials that have been shredded, magnetically separated or milled to a particle size below one millimeter.

The technology was selected for a 2016 TechConnect National Innovation Award, which recognizes early-stage innovations from around the world through an industry review of the top 15 percent of technologies submitted to the annual TechConnect National Innovation Summit. The work was funded by the Department of Energy's Critical Materials Institute, an Energy Innovation Hub.

Metals in Electronics

Electronics are a concentrated source of metals, and recycling end-of-life consumer products can help manage future increases in demand, reduce the impact of mining, and divert waste from landfills and toxic incineration processes. With the rapid growth and turnover of mobile electronics, an effective and environmentally responsible recycling system is imperative. Devices constantly change but the metals that compose them remain largely the same.

In many cases, post-consumer electronic recycling only targets precious metals such as gold, silver and palladium.

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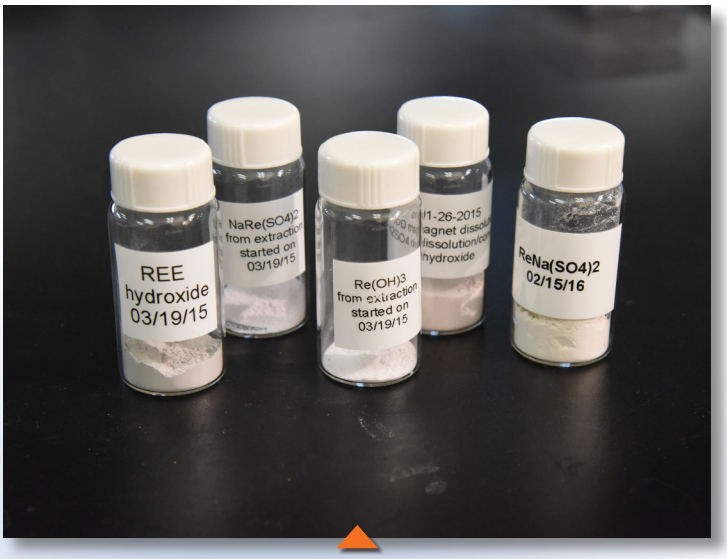
Including more elements in the reclamation scheme increases the value obtained from recovery capacity and decreases the generation of waste volume. INL's E-RECOV method reclaims base metals and rare earth elements before the precious metals are extracted, which reduces impurities. Base metals include valuable zinc, tin, lead, nickel and copper. REEs are lanthanides (elements with atomic numbers 57 to 71) that can be found in products such as fluorescent and LED light bulbs, mobile electronics, electric vehicles, wind turbines and solar panels. Although rare earth elements are difficult and expensive to obtain, and the U.S. has a limited supply that is vulnerable to disruption, no significant REE recycling is currently practiced.

Recycling Electronics

The bulk of electronics that are processed for metal recovery are sent overseas, using unsustainable acid-solution leaching or toxic combustion processes that lack environmental and worker safety practices. Unlike acid leaching, INL's method does not consume acid and continuously regenerates the initial oxidizer at the anode, which supports long-term operation without chemical consumption. This reduces reagent use and lessens the toxicity of remaining materials compared with current practices. The method is sustainable, safe and environmentally friendly. Processing can be done domestically, which further lessens the environmental impact from exportation.

E-RECOV is also economical. With smart recycling methods, using U.S. labor and reducing the export expenses, operating and capital costs are significantly lower than mining. This is important because supply chains for many technologies could experience major disruptions if there is a shortage of REE materials. While gold is the primary driver of recoverable value from waste electronics, copper is the most concentrated nonferrous (lacking iron) metal.



Recovered material after electrochemical processing.

Summary

Recovering more metal from waste electronics provides an opportunity to change an exported and wasteful resource into a valuable domestic commodity. INL's metal recycling method reclaims more value materials, reduces reagent use and lessens the toxicity of remaining materials than current practices for salvage of metals from waste electronics.

For more information

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